WORKING PAPER 21

# Malaria Risk Mapping in Sri Lanka—Results from the Uda Walawe Area

## Proceedings of a Workshop held in Embilipitiya, Sri Lanka 29th March 2001

Eveline Klinkenberg, Editor

IWMI
International Water Management Institute

FUTURE HARVEST
IWMI is a Future Harvest Center supported by the CGIAR

Working Paper 21

# Malaria Risk Mapping in Sri Lanka—Results from the Uda Walawe Area

***Proceedings of a Workshop***

***held in Embilipitya, Sri Lanka***

***29 March 2001***

*Eveline Klinkenberg, Editor*

International Water Management Institute

IWMI receives its principal funding from 58 governments, private foundations, and international and regional organizations known as the Consultative Group on International Agricultural Research (CGIAR). Support is also given by the Governments of Pakistan, South Africa and Sri Lanka.

IWMI gratefully acknowledges the support for its work on vector control by the Government of Japan.

The work in Uda Walawe was carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada.

Klinkenberg, E. (ed.) 2001. *Malaria risk mapping in Sri Lanka—results from the Uda Walawe area: Proceedings of a workshop held in Embilipitiya, Sri Lanka, 29 March 2001*. Colombo, Sri Lanka: International Water Management Institute. (IWMI working paper 21).

*/ water management / irrigation management / health / waterborne diseases / malaria / disease vectors / mapping / GIS / remote sensing / Sri Lanka /*

ISBN 92-9090-445-3



*Cover photograph:* Kukul Katuwa Wewa, an abandoned tank in the Thanamalvilla area in Sri Lanka by Eveline Klinkenberg

Please direct inquiries and comments to: *iwmi-research-news@cgiar.org*

## Contents

# 1. INTRODUCTION

This working paper contains the proceedings of the workshop on "Malaria Risk Mapping in Sri Lanka—Results from the Uda Walawe Area" that was held on March 29, 2001 at the Hotel Centauria in Embilipitiya. The objective of the Workshop, organized by IWMI's Water, Health and Environment Theme, was to discuss the results of the malaria risk mapping work carried out to date in the Uda Walawe area, with the collaboration of staff involved in malaria control work in the area and from the Divisional Secretaries and Land use planning Offices. These staff were invited to participate in the Workshop.

The main objectives of the workshop were to:

1. Present and discuss the results of the research findings of the malaria risk mapping project in the Uda Walawe region.
2. Discuss the malaria pattern in the Uda Walawe region.
3. Discuss the possible risk factors in the different Divisional Secretary Divisions (DSDs).
4. Discuss the role that risk mapping could play in planning of malaria control activities.
5. Discuss and present IWMI's research in Southern Sri Lanka

An important aspect of the workshop was the discussion of the results with the participants. These discussions (see chapter 5 & 6) provided an important feedback to the results of the project and also provided additional insights into the underlying factors influencing the observed malaria pattern.

# 2. WORKSHOP PROGRAM

| Time | Topic | Speaker |
|---|---|---|
| 09:30 hrs. to 09:50 hrs. | Welcome and Introduction to IWMI | Dr. Felix Amerasinghe, IWMI |
| 09:50 hrs. to 10:00 hrs | Objective of the Workshop | Dr. D. Gunawardena, IWMI |
| 10:00 hrs. to 10:10 hrs. | Malaria Pattern in Embilipitiya | Mr. N.B. Munasingha, RMO, Embilipitiya |
| 10:10 hrs. to 10:40 hrs. | Malaria Vectors in Sri Lanka: Sibling species and their role in malaria transmission | Dr. Felix Amerasinghe, IWMI |
| 10:40 hrs. to 11:00 hrs. | TEA | |
| 11:00 hrs. to 11:45 hrs. | IWMI research in Southern Sri Lanka | Dr. Wim van der Hoek, IWMI |
| 11:45 hrs. to 12:15 hrs. | Malaria surveillance and spatial targeting of interventions | Dr. D. Gunawardena and Mr. Lal Mutuwatte, IWMI |
| 12:15 hrs. to 13:00 hrs. | Findings of the Malaria Risk Mapping Study | Ms. Eveline Klinkenberg, IWMI |
| 13:00 hrs. to 14:00 hrs. | LUNCH | |
| 14:00 hrs. to 15:00 hrs. | Group Assignment [one group per DSD – average 10 persons] | |
| 15:00 hrs. to 15:15 hrs. | TEA | |
| 15:15 hrs. to 16:30 hrs. | Group presentations [15 minutes per group] | |
| 16:30 hrs. to 17:00 hrs. | Discussions and conclusions | All participants |

**Group Assignment**

All participants were grouped according to their Divisional Secretary Divisions: Sooriyawewa, Embilipitiya, Angunukolapelessa, Ambalantota, Thanamalvilla/Sevenagala, totaling five groups. Following lunch, the groups met to discuss among themselves the questions raised below. One hour was assigned for the group work and each group was provided with a map of their DSD with Grama Niladari (GN) boundaries indicated, to use for their presentation and discussion.

Questions addressed in the group work:

1. Is it possible to identify high risk areas for malaria in the Division?
2. If yes, which s are the high risk areas? [Please indicate on map provided.]
3. Are there known environmental risk factors in the Division, i.e. certain surface water sources, vegetation and cultivation patterns, gem mining, etc. Where are they located?
4. Could risk mapping play a role in planning of malaria control activities in the Division?
5. Explain how.

During the hour every group prepared a small summary of their relevant DS Division which was then presented to the rest of the groups in a short presentation of 10 minutes per group. Five minutes were allocated for discussion. The presentations and discussions of all the groups were followed by a general discussion, among all the participants, for the whole area.

# 3. RISK MAP PROJECT OUTLINE

The overall project objective is to develop a risk map for malaria covering the whole of Sri Lanka. Such a map would make it possible for the relevant Health Divisions to better target their malaria control activities to high-risk areas and prepare themselves for impending epidemics. Apart from a general focus on the whole island, several areas are to be studied in detail to find if a relationship exists, at micro scale, among mosquito development, malaria incidence, land use and meteorological features. As a first step to developing such a map, a risk-mapping project was carried out in the Uda Walawe region. Apart form this project, IWMI's Water, Health & Environment Theme is carrying out several other projects in Sri Lanka to study in more detail the interaction between mosquitoes and their environment.

**Uda Walawe Area**

For this study six Divisional Secretary Divisions (DSDs) in the Uda Walawe area were selected: Embilipitiya, Thanamalvilla, Sevenagala, Angunukolapelessa, Ambalanatota and Sooriyawewa. These areas were mapped at Grama Niladari (GN), the smallest administrative boundary in Sri Lanka, level, with the available data of malaria cases for the period 1991-2000 that were reported to the health facilities within the 5 DSDs. Plotting of these cases on maps showed the areas with high and low malaria incidences, which would allow for targeting of malaria control activities in the future. These malaria incidence patterns were related to possible parameters such as presence of irrigation, land use, anti-mosquito measures (e.g. bednets/coils), meteorological data (rainfall/ humidity), control activities (e.g. house-spraying), socio-economic status, presence of cattle etc.

**Moneragala Area**

A study similar to the study carried out in the Uda Walawe region is being undertaken in the Moneragala District, one of the most malarious regions in Sri Lanka. In this study a special focus is to relate soil moisture data obtained from satellite images to malaria incidence in epidemic outbreaks to see if soil moisture data could serve as a tool in a malaria epidemic forecasting system.

**Huruluwewa Area**

Since 1994 IWMI has been carrying out research in the Huruluwewa area in close collaboration with the Anit Malaria Campaign (AMC), the University of Peradeniya and the Mahaweli Authority of Sri Lanka. Between 1994 and 1998 several studies were conducted to increase the knowledge of malariology in the context of a traditional Sri Lankan dry zone environment with extensive irrigated agriculture, and to assess the feasibility of new control interventions. An insight was gained in anopheline larval ecology, transmission dynamics, the economic burden of malaria to households and the knowledge, practices and attitudes regarding malaria. The work focused on the development of water management methods for malaria control. IWMI's future research will test whether management of water flow in Sri Lanka's Yan *Oya* (River) can effectively reduce breeding of the major malaria carrier mosquito in this region. This work will identify water management scenarios that regulate water depth to decrease the mosquitoes' possibilities to breed. An important factor in this project is to ensure that new water management techniques are integrated into current irrigation practices.

# 4. PRESENTATIONS

**Malaria Pattern in Embilipitiya DSD**

*Mr. N.B. Munasingha, RMO Embilipitiya*

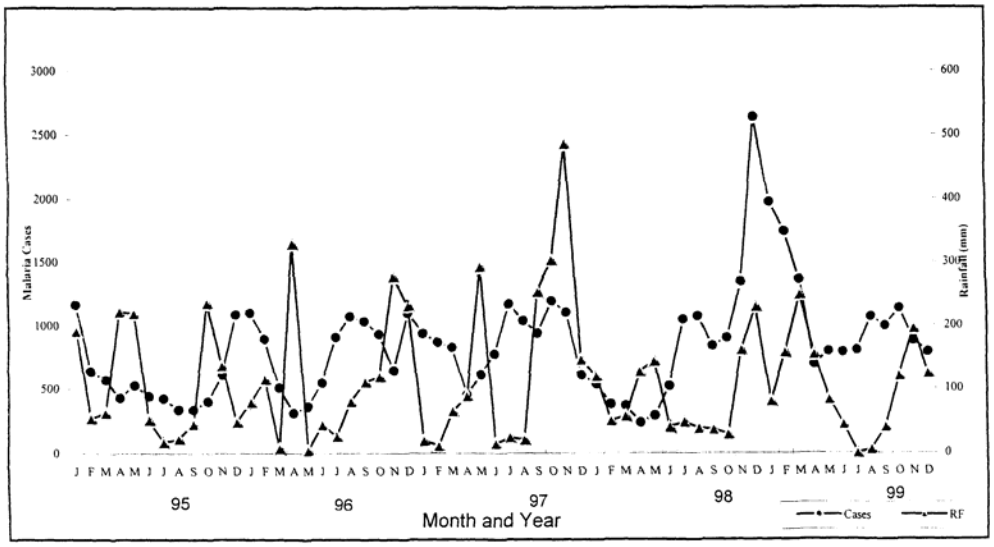
In the Ratnapura District there are 3 MOH divisions with a high number of malaria cases: Balangoda, Opanayaka and Embilipitiya. The yearly number of cases in these divisions is around 2000-3000 a year while in the rest of the divisions this is range from 0 to 300. In the period 1995-1999 there was an increase in the number of cases in these three divisions (see table below).

| MOH Division | # positives 1995 | # positives 1996 | # positives 1997 | # positives 1998 | # positives 1999 |
|---|---|---|---|---|---|
| Embilipitiya | 1150 | 1167 | 2414 | 3201 | 3879 |
| Balangoda | 2818 | 5683 | 2884 | 2012 | 3064 |
| Opanayaka | 699 | 240 | 2836 | 1565 | 1708 |

The AMC has classified malaria risk in three categories: high risk, moderate risk and low risk according to the API and the percentage of cases caused by *Plasmodium falciparum* (PF). For the Embilipitiya DSD the distribution of malaria risk is shown in the table below. Embilipitiya has the highest API of the Ratnapura District. The high risk areas are concentrated around the Uda Walawe tank. High risk areas are: Panahaduwa, Uda Walawe and Thimbolketiya (Mahaweli Special area). The disease pattern in Embilipitiya closely follows the national pattern.

| | High Risk | Moderate Risk | Low Risk |
|---|---|---|---|
| Number of GNs | 3 | 27 | 10 |
| API | >100 | 50-100 | <50 |
| PF | > 30% | 20-30% | <20% |

There seems to be a correlation between the malaria cases in the Embilipitiya area and the rainfall pattern. Peaks in cases often occur after peaks of rainfall (see figure).

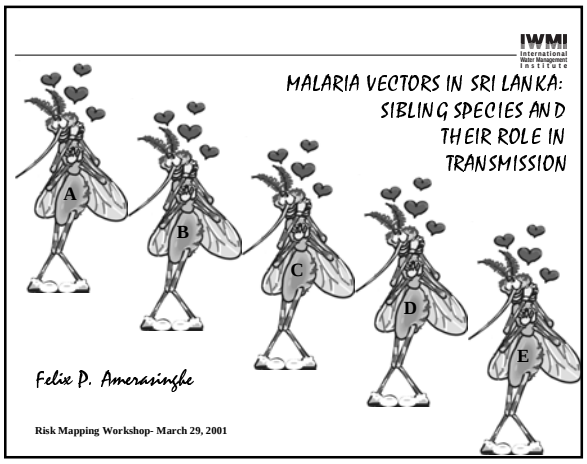


**Malaria Vectors in Sri Lanka: Sibling Species and Their Role in Transmission**

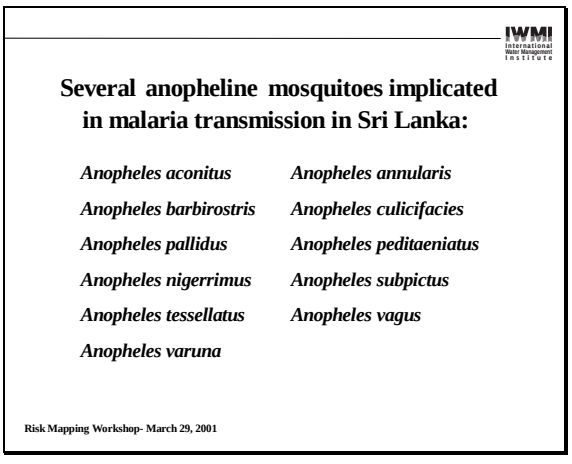
*Dr. Felix P. Amerasinghe, IWMI*

Several species of anopheline mosquitoes have been implicated in malaria transmission in Sri Lanka. These include *Anopheles aconitus, An. annularis, An. barbirostris, An. culicifacies, An. pallidus, An. peditaeniatus, An. nigerrimus, An. subpictus, An. tessellatus An. vagus*, and *An. varuna*. Of these species, *An. culicifacies* is regarded as the primary vector in the country. *Anopheles subpictus* is generally regarded as the next most important species, with *An. annularis* and *An. vagus* as species that also seem to be locally important at times. Chromosomally distinct sibling species have been recognized in several of these morphospecies. *An. culicifacies* consists of 5 siblings (A, B, C, D and E). Siblings B and E have been recognized in Sri Lanka, and based on evidence from south India, it is now considered that sibling E is the major vector while sibling B is a poor vector. Nothing is known of the ecology and behavior of the newly recognized sibling E, and this is an area that needs immediate investigation. Two sibling species (A, B) have been recognized in Indian populations of *An. annularis*: the status of this species in Sri Lanka is unknown. Four sibling species (A, B, C, D) of *An. subpictus* have been identified in India and Sri Lanka, with sibling B a brackish water breeding species whose adults are extremely susceptible to insecticides. One unpublished study on the ecology of these siblings species has been carried out in Sri Lanka, during which evidence for malaria parasite carriage was obtained from field caught females of sibling C. *An. barbirostris* also consists of 2 sibling species but the status of populations in south Asia in unknown. Among other Sri Lankan anophelines, *An. maculatus* is known to consist of a complex of 9 sibling species. The status of the population in Sri Lanka is unknown, but the species is not regarded as a malaria vector in Sri Lanka.

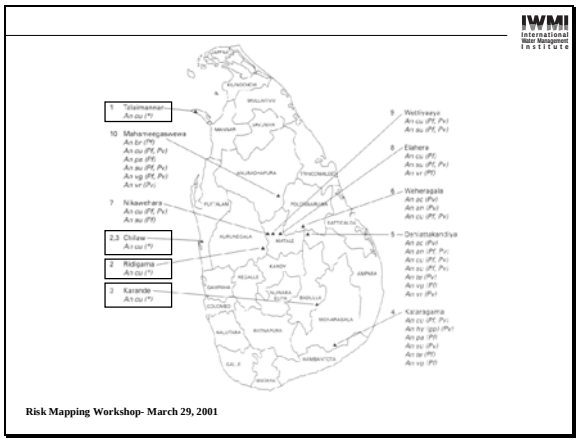
**Powerpoint slides of the presentation:**




Slide 1




Slide 2




Slide 3 - see figure 1

## Sri Lanka

**All evidence points to the major vector being *Anopheles culicifacies*.**

**Evidence also indicates that *An. subpictus* is a secondary vector.**

**Other species that could be locally important in transmission are: *An. annularis*, *An. tessellatus*, *An. vagus* and *An. varuna*.**

Risk Mapping Workshop- March 29, 2001

Slide 4

**Sibling species can be detected on the basis of:**

- **Inversions on polytene chromosomes**
- **Structural variations in metaphase Y-chromosomes**
- **Electrophoretic variations in LDH-enzymes**
- **Species-specific cuticular hydrocarbon profiles**
- **DNA-probes**
- **Polymerase Chain Reaction (PCR) assays**

Risk Mapping Workshop- March 29, 2001

Slide 5

**Sibling species can be detected on the basis of:**

- **Inversions on polytene chromosomes**
- **Structural variations in metaphase Y-chromosomes**
- **Electrophoretic variations in LDH-enzymes**
- **Species-specific cuticular hydrocarbon profiles**
- **DNA-probes**
- **Polymerase Chain Reaction (PCR) assays**

Risk Mapping Workshop- March 29, 2001

Slide 6

***Anopheles culicifacies* consists of a complex of 5 sibling species (A, B, C, D, E,)**

**INDIA**

| | A | B | C | D | E |
|---|---|---|---|---|---|
| **% Human Biting** | **0-4** | **0-1** | **0-3** | **0-1** | **?** |
| **Biting Activity** | **All Night** | **All Night** | **All Night** | **Upto Midnight** | **?** |
| **Peak biting** | **22-23** | **22-23** | **18-24** | **18-24** | **?** |
| **PV/PF** | **vector** | **non/poor vector** | **vector** | **vector** | **vector** |
| **Sporozoite Rate** | **0.51** | **0.04** | **0.30** | **0.40** | **0.46** |

Risk Mapping Workshop- March 29, 2001

Slide 7

## In Sri Lanka: *An. culicifacies*

**Hitherto: only B occurred, and was the major vector.**

**Now: B and E have been identified (Surendran et al. 2000).**

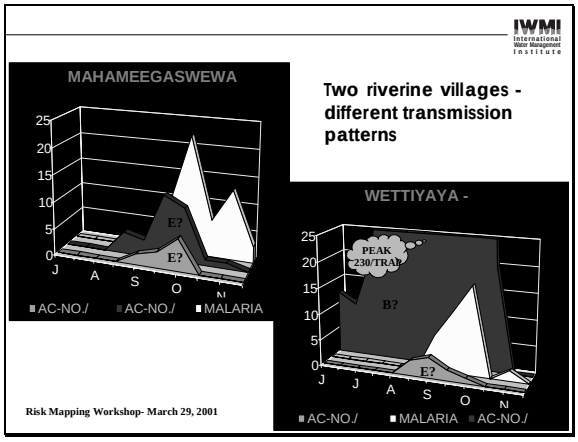
**The both siblings occurred in:**
- **Moneragala District (Pelawatta)**
- **Puttalam Disttrict (Elivitiya)**
- **Trincomalee District (Puliyankulam)**

**Only sibling E occurred in Badulla District (Aluthwela)**

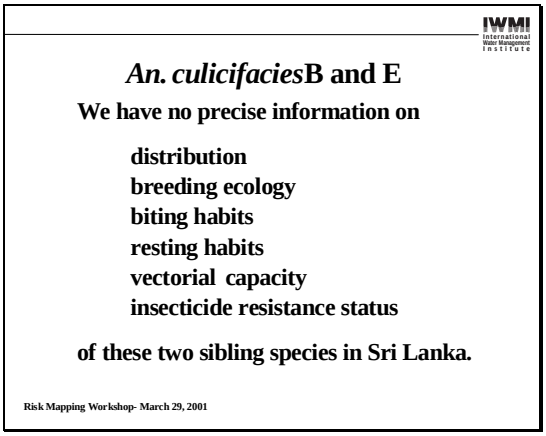
**Based on the limited study done, E seems to be more common than B.**

Risk Mapping Workshop- March 29, 2001

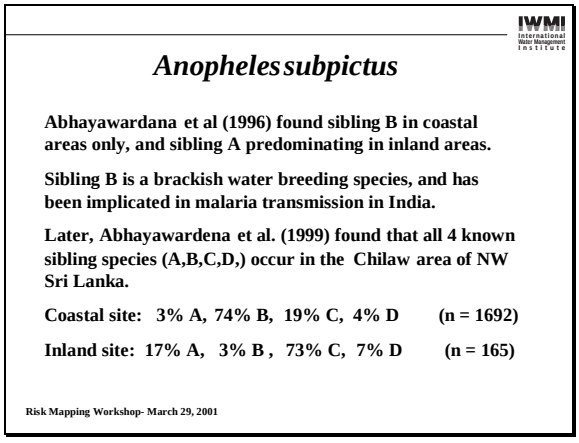
Slide 8



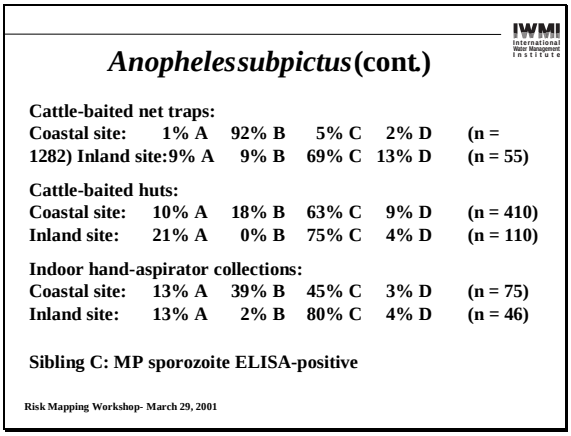

Slide 9



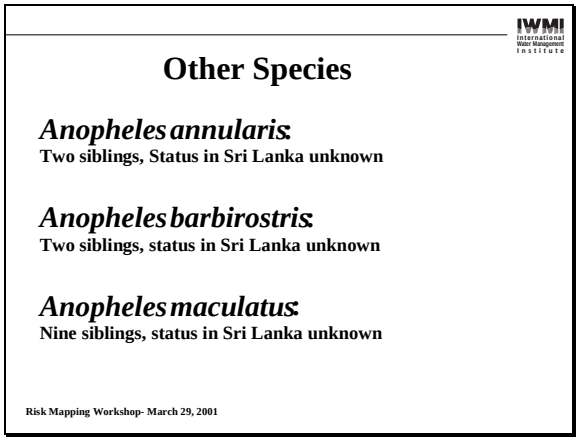

Slide 10




Slide 11




Slide 12




Slide 13

Figure 1. Sites of vector incrimination studies in Sri Lanka and species found. Reproduced after Konradsen et al., 2000.